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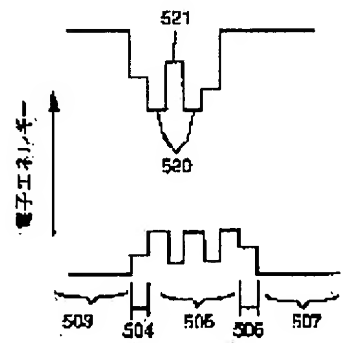
(54) SEMICONDUCTOR LASER ELEMENT

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a semiconductor layer element wherein a threshold value current is reduced with no increased operation voltage, while oscillation wavelength deviation is prevented.

SOLUTION: Relating to a semiconductor layer element wherein a first guide layer 104 and a second guide layer 106 are provided with an active layer 105 of multiplex quantum well structure in between, the first guide layer 104 and the second guide layer 106 are adjoined to a quantum well layer 120, and the forbidden band width of the first guide layer 104 and the second guide layer 106 is wider than that of the quantum well layer 120, while at least one forbidden band width of the first guide layer 104 and the second guide layer 106 is narrower than that of a quantum barrier layer 121.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the structure of a semiconductor laser component of having the barrier layer of multiplex quantum well structure especially, about the semiconductor laser component used as the light source in fields, such as an optical disk, a laser beam printer, and optical transmission.
[0002]
[Description of the Prior Art] For low-current-izing of a semiconductor laser component, using for a barrier layer the multiplex quantum well (MQW:Multiple QuantumWell) barrier layer which prepared the thickness below the electronic de Broglie wavelength, i.e., quantum well layer about 20nm or less, in multiplex is indicated by JP,4-67354,B.
[0003] As shown in drawing 13 , this semiconductor laser component has the structure where the laminating of the n-GaAs buffer layer 702, the n-AlGaAs cladding layer 703, the n-AlGaAs guide layer 704, the MQW barrier layer 705, the p-AlGaAs guide layer 706, the p-AlGaAs cladding layer 707, and the p-GaAs cap layer 708 was carried out one by one on the n-GaAs substrate 701.
[0004] Here, the MQW barrier layer 705 consists of two or more GaAs quantum well layers 710 and an AlGaAs quantum barrier layer 711 inserted in the quantum well layer 710, and is constituted by the mutual repeat by three layers of this quantum well layer, and quantum barrier layer two-layer.
[0005] Drawing 14 is the energy band diagram of each class in this MQW barrier layer 705 neighborhood. The forbidden-band width of face of the n-AlGaAs guide layer 704 and the p-AlGaAs guide layer 706 is both set up equally to the forbidden-band width of face of the quantum barrier layer 711. Since the quantum well layer 710 is altogether pinched in the semi-conductor layer of the same forbidden-band width of face by making equal forbidden-band width of face of the guide layers 704 and 706, and forbidden-band width of face of the quantum barrier layer 711, when the flare of quantization level becomes small between the quantum well layers 710 and an emission spectrum becomes narrow, reduction of a threshold current is attained.
[0006]
[Problem(s) to be Solved by the Invention] By the way, in the latest semiconductor laser component, if the further reduction of a threshold current is demanded and a threshold current is not further reduced in the above-mentioned conventional example, the light to the quantum well layer of a MQW barrier layer needs to shut up, and it is necessary to increase a rate. Therefore, thickness of a guide layer was thickened in the conventional example.
[0007] However, the problem which describes below that the thickness of a guide layer thickens occurs.
[0008] Generally, in order to control the dopant diffusion to a MQW barrier layer from a guide layer, the dopant concentration of a guide layer is usually set up quite lower than the dopant concentration of a cladding layer, or is set as a non dope. Therefore, if a guide layer is thickened, operating voltage will increase influenced by the component resistance of buildup in a guide layer. Therefore, in the conventional example, although the threshold current could be reduced, the new problem of the property

aggravation by buildup of operating voltage had arisen.
[0009] Moreover, in this conventional example, the forbidden-band width of face of a guide layer is set up equally to the forbidden-band width of face of a quantum barrier layer. until this is the same as aluminum presentation ratio of a quantum barrier layer in aluminum presentation ratio of a guide layer -- it is equivalent to setting up highly. Therefore, in this case, the dopant from a cladding layer was spread to the barrier layer, aluminum presentation ratio of a quantum well layer becomes easy to change, oscillation wavelength shifted from the set point, and the problem that wavelength control became difficult had arisen.
[0010] This invention does not solve the technical problem of such a conventional technique, and aims. at offering the semiconductor laser component which can reduce a threshold current, without being accompanied by buildup of operating voltage.
[0011] Moreover, other objects of this invention are to offer the semiconductor laser component which can prevent an oscillation wavelength gap collectively.
[0012]
[Means for Solving the Problem] The semiconductor laser component of this invention sandwiches the barrier layer of the multiplex quantum well structure which consists of a quantum barrier layer inserted in two or more quantum well layers and these two or more quantum well layers. It is the semiconductor laser component in which the 1st guide layer and the 2nd guide layer were prepared. While making this 1st guide layer and this 2nd guide layer adjoin this quantum well layer, forbidden-band width of face of this 1st guide layer and this 2nd guide layer is made larger than the forbidden-band width of face of this quantum well layer. And it comes it smaller than the forbidden-band width of face of this quantum barrier layer to carry out one [at least] forbidden-band width of face of this 1st guide layer and this 2nd guide layer, and the above-mentioned object is attained by that.
[0013] It considers as the configuration which the 1st cladding layer of the 1st conductivity type and the 2nd cladding layer of the 2nd conductivity type are preferably prepared so that said 1st guide layer and said 2nd guide layer may be pinched, and prepares the saturable absorption layer which is by carrying out between this 1st cladding layer and this 2nd cladding layer as for the laser oscillation luminous energy of said barrier layer, abbreviation, etc., and has luminescence energy.
[0014] Moreover, preferably, the 1st cladding layer of the 1st conductivity type and the 2nd cladding layer of the 2nd conductivity type are prepared so that said 1st guide layer and said 2nd guide layer may be pinched. Are the outside of this 2nd cladding layer and the 3rd cladding layer of the 2nd conductivity type is prepared in the location of this 1st cladding layer and an opposite hand. It considers as the configuration which prepares the saturable absorption layer which is by carrying out between this 1st cladding layer and this 3rd cladding layer as for the laser oscillation luminous energy of said barrier layer, abbreviation, etc., and has luminescence energy.
[0015] Moreover, preferably, the 1st cladding layer of the 1st conductivity type and the 2nd cladding layer of the 2nd conductivity type are prepared so that said 1st guide layer and said 2nd guide layer may be pinched. Are the outside of this 2nd cladding layer and the 3rd cladding layer of the 2nd conductivity type is formed in the location of this 1st cladding layer and an opposite hand in the shape of a stripe. Difference deltan of the rate na of optical refraction confined in the barrier layer inside a stripe and the rate nb of optical refraction confined in the barrier layer of the stripe exterior is condition 2x10-3 <=deltan<=7x10-3 of following the (1) type.... (1)
It considers as a ******** configuration.
[0016] Moreover, preferably, the 2nd cladding layer of said 2nd conductivity type is p mold cladding layer, and said 2nd guide layer is located in this p mold cladding layer side, and considers as the configuration which made forbidden-band width of face of this 2nd guide layer smaller than the forbidden-band width of face of said quantum barrier layer.
[0017] Moreover, forbidden-band width of face of the smaller one is preferably considered as the configuration made larger than the forbidden-band width of face equivalent to the laser oscillation luminous energy of said barrier layer among the forbidden-band width of face of said 1st guide layer or said 2nd guide layer.

[0018] Moreover, when forbidden-band width of face which is [width of face / of the smaller one / forbidden-band] equivalent to Eb and the laser oscillation luminous energy of said barrier layer in the forbidden-band width of face of Eg and said quantum barrier layer among the forbidden-band width of face of said 1st guide layer or said 2nd guide layer is preferably set to Elambda, Eg, Eb, and Elambda are the conditions of following the (2) type. Elambda+100 meV<=Eg<=Eb-50meV .... (2)
It considers as a ******** configuration.
[0019] Below, an operation of this invention is explained.
[0020] In the above-mentioned configuration, it is equivalent to setting up the refractive index of a guide layer more greatly than the refractive index of a quantum barrier layer to make forbidden-band width of face of a guide layer smaller than the forbidden-band width of face of a quantum barrier layer. Therefore, the light to the quantum well layer of a MQW barrier layer shuts up, a rate increases, and a threshold current decreases. And since it is not necessary to thicken thickness of a guide layer like the above-mentioned conventional example for reduction of a threshold current, buildup of the operating voltage accompanying buildup of component resistance is also controlled.
[0021] Moreover, in the case of for example, aluminum system semi-conductor layer, it is equivalent to setting up aluminum presentation ratio of a guide layer smaller than aluminum presentation ratio of a quantum barrier layer to make forbidden-band width of face of a guide layer smaller than the forbidden-band width of face of a quantum barrier layer. For this reason, the dopant diffusion to a guide layer from a cladding layer is controlled. Therefore, since the dopant diffusion to a MQW barrier layer is controlled, change of aluminum presentation ratio of the quantum well layer of a MQW barrier layer is controlled, and an oscillation wavelength gap is prevented.
[0022] Moreover, it is equivalent to controlling a refractive index to control the forbidden-band width of face of a guide layer. Therefore, the refractive index of two guide layers is set as a respectively suitable value, and it becomes possible to adjust a vertical radiation angle.
[0023] Furthermore, the number of the nonluminescent recombination level of a guide layer decreases by setting up aluminum presentation ratio of a guide layer smaller than aluminum presentation ratio of a quantum barrier layer. For this reason, nonluminescent recombination is controlled to the carrier which began to leak from a quantum well layer to the guide layer. Consequently, a carrier is used effective in luminescence and the reduction of a threshold current of it is attained.
[0024] In addition, in depending the saturable absorption layer which is in the forbidden-band width of face of the laser oscillation light of a MQW barrier layer, abbreviation, etc. by carrying out, and has the forbidden-band width of face of luminescence energy on the configuration prepared between two cladding layers (for example, between the 1st cladding layer of the above, and the 2nd cladding layer of the above), or between the 1st cladding layer of the above, and the 3rd cladding layer of the above, the self-oscillation which laser oscillation light oscillates in the shape of a pulse according to the saturable absorption effectiveness happens. In the state of self-oscillation, the longitudinal mode of laser turns into a multimode, and the spectral line width of each longitudinal mode spreads. For this reason, the coherency of laser falls, it is hard coming to win popularity the effect by return light, and a noise is reduced.
[0025] In addition, when based on the configuration which prepares this saturable absorption layer, diffusion is controlled for the dopant of the cladding layer between a MQW barrier layer and a saturable absorption layer in a saturable absorption layer, and it is possible that the diffusion by the side of a MQW barrier layer increases. However, since aluminum presentation ratio of a guide layer is set up smaller than aluminum presentation ratio of a quantum barrier layer, the dopant diffusion to a guide layer from a cladding layer is controlled. Therefore, since the dopant diffusion to a MQW barrier layer is controlled, change of aluminum presentation ratio of the quantum well layer of a MQW barrier layer is controlled, and an oscillation wavelength gap is prevented.
[0026] Furthermore, if the stripe-like 3rd cladding layer is prepared and the above-mentioned refractive-index difference deltan is set up within the limits of the above-mentioned (1) formula, the amount of saturable absorption in the barrier layer of the stripe exterior increases, and self-oscillation will break out, confining light in the interior of a stripe. Consequently, it is hard coming to win popularity the

effect of the wave front by the saturable absorption effectiveness of the stripe exterior, and a gap of the spot location of synchrotron orbital radiation horizontal to a barrier layer becomes small. That is, the astigmatic difference decreases and an optical property improves.

[0027] Moreover, for example, especially by the AlGaInP system cladding layer, it is in the inclination which the dopant of p mold cladding layer tends to diffuse compared with an AlGaAs system cladding layer depending on the class of cladding layer. Therefore, if it is in such a cladding layer, by making forbidden-band width of face of the 2nd guide layer by the side of p mold cladding layer smaller than the forbidden-band width of face of a quantum barrier layer, the diffusion to the barrier layer of a dopant is controlled and the above-mentioned wavelength gap is prevented much more effectively.

[0028] Moreover, if the forbidden-band width of face of a guide layer with the smaller forbidden-band width of face between two guide layers is set up more greatly than the forbidden-band width of face equivalent to the laser oscillation luminous energy of a barrier layer, it will become possible to reduce a threshold current much more effectively, as shown in drawing 3 .

[0029] It becomes possible to reduce a threshold current much more effectively especially, as it is shown in drawing 3 , when the forbidden-band width of face Eg of a guide layer with the smaller forbidden-band width of face between two guide layers is set up so that the relation of the above-mentioned (2) formula may be filled.

[0030]

[Embodiment of the Invention] The gestalt of operation of this invention is concretely explained based on a drawing below.

[0031] (Operation gestalt 1) Drawing 1 and drawing 2 show the operation gestalt 1 of the semiconductor laser component of this invention.

[0032] As shown in drawing 1 , this semiconductor laser component On the n-GaAs substrate 101 The n-GaAs buffer layer 102 of 0.5 micrometers of thickness, the 1st cladding layer 103 of n-aluminum0.5Ga0.5As of 1.5 micrometers of thickness, the 1st guide layer 104 of aluminum0.25Ga0.75As of 15nm of thickness, the non dope MQW barrier layer 105, The 2nd guide layer 106 of aluminum0.25Ga0.75As of 15nm of thickness, The 2nd cladding layer 107 of p-aluminum0.5Ga0.5As of 0.2 micrometers of thickness, the p-GaAs etching stopper layer 108 of 0.003 micrometers of thickness, the 3rd cladding layer 109 of p-aluminum0.5Ga0.5As of 1.2 micrometers of thickness, and the p-GaAs cap layer 110 of 0.8 micrometers of thickness It has the structure which carried out the laminating one by one by metal-organic chemical vapor deposition (MOCVD law).

[0033] Here, the MQW barrier layer 105 consists of an aluminum0.1Ga0.9As quantum well layer 120 of 8nm of thickness, and an aluminum0.35Ga0.65As quantum barrier layer 121 of 5nm of thickness, as shown in drawing 2 , and it is constituted by the mutual repeat by three layers of this quantum well layer, and quantum barrier layer two-layer. In addition, the forbidden-band width of face of each semi-conductor layer is decided by aluminum presentation ratio.

[0034] In addition, since the thickness of the P-GaAs etching stopper layer 108 is very as thin as 0.003 micrometers, light shuts up an etching stopper layer and it does not affect an operation or internal optical absorption. Moreover, the etching stopper layer is useful although the ridge stripe described below is formed with sufficient control by etching. However, also when there is no etching stopper layer, it is possible to control etching by time amount to ridge stripe formation.

[0035] Next, the stripe mask which consists of a photoresist is formed in the front face of the above-mentioned layered product, etching is stopped on the front face of the p-GaAs etching stopper layer 108 by selective etching, and the ridge stripe 111 with a stripe width of face [of a pars basilaris ossis occipitalis] of 2.2 micrometers is formed.

[0036] the both sides of the ridge stripe 111 are embedded -- as -- the 1st current optical confinement layer 112 of n-aluminum0.7Ga0.3As of 0.6 micrometers of thickness, the 2nd current confining layer 113 of n-GaAs of 0.3 micrometers of thickness, and the p-GaAs flattening layer 114 of 0.3 micrometers of thickness -- MOCVD -- sequential growth is carried out by law.

[0037] Next, the p-GaAs contact layer 115 of 3 micrometers of thickness is grown up by the law of MOCVD so that the front face of the p-GaAs cap layer 110 and the p-GaAs flattening layer 114 may be

covered. n mold electrode 116 and p mold electrode 117 are formed in n-GaAs substrate 101 front face and p-GaAs contact layer 115 front face, respectively. Cavity length is adjusted to 375 micrometers by the cleavage method, and 10%, the end-face reflection factor by the side of the optical outgoing radiation of a resonator end face forms aluminum203 film and Si film in each end face so that the end-face reflection factor on the backside may become 75%.

[0038] In the semiconductor laser component of this operation gestalt 1, when forward voltage was impressed between n mold electrode 116 and p mold electrode 117, slope effectiveness 1.0 W/A of the oscillation wavelength of 0.78 micrometers, the threshold current of 15mA, and a current-optical output property, 50mA of operating currents in 35mW of optical outputs, and operating voltage 1.8V were obtained.

[0039] On the other hand, it is set to the threshold current of 25mA, 60mA of operating currents, and operating voltage 1.8V when forbidden-band width of face of the 1st guide layer 704 of the conventional example and the 2nd guide layer 706 is made equal to the forbidden-band width of face of the quantum barrier layer 711 (i.e., when aluminum presentation ratio of the 1st guide layer 704 and the 2nd guide layer 706 is set to 0.35) (conventional gestalt 1).

[0040] Thus, with the semiconductor laser component of this operation gestalt 1, the threshold current was able to be reduced from 25mA to 15mA, without being accompanied by buildup of operating voltage. The result is shown in a table 1.

[0041]

[A table 1]

	本実施形態	従来形態1
閾値電流	15mA	25mA
動作電流	1.8V	1.8V

[0042] Moreover, when the thickness of the 1st guide layer 704 and the 2nd guide layer 706 is thickly set up to 50nm (conventional gestalt 2), a threshold current can be reduced to the same 15mA as this operation gestalt. However, the problem of increasing to 2.1V generates operating voltage in that case for buildup of the component resistance by buildup of the thickness of the guide layers 704 and 706. The result is shown in a table 2.

[0043]

[A table 2]

	本実施形態	従来形態2
閾値電流	15mA	15mA
動作電流	1.8V	2.1V

[0044] With this operation gestalt 1, to the set point of 0.78 micrometers of oscillation wavelength, the oscillation wavelength of the produced semiconductor laser component is also set to 0.78 micrometers, and can perform control of oscillation wavelength. On the other hand, conventionally [above-mentioned], to the set point of 0.78 micrometers of oscillation wavelength, in the case of a gestalt 1, a wavelength gap takes place [oscillation wavelength] to 0.775 micrometers, and control of oscillation wavelength becomes difficult.

[0045] With the semiconductor laser component of this operation gestalt 1, while making the 1st guide layer 104 and the 2nd guide layer 106 adjoin the quantum well layer 120 as shown in drawing 2 , forbidden-band width of face of the 1st guide layer 104 and the 2nd guide layer 106 is made larger than the forbidden-band width of face of the quantum well layer 120, and forbidden-band width of face of the 1st guide layer 104 and the 2nd guide layer 106 is made smaller than the forbidden-band width of face of the quantum barrier layer 121.

[0046] Here, it is equivalent to setting up smaller than aluminum presentation ratio of the quantum barrier layer 121 aluminum presentation ratio of the guide layers 104 and 106 to make forbidden-band width of face of the 1st guide layer 104 and the 2nd guide layer 106 smaller than the forbidden-band width of face of the quantum barrier layer 121. For this reason, the dopant diffusion to the guide layers 104 and 106 from cladding layers 103 and 107 is controlled. Therefore, since the dopant diffusion to the

MQW barrier layer 105 is controlled, change of aluminum presentation ratio of the quantum well layer 120 of the MQW barrier layer 105 is controlled, and an oscillation wavelength gap is prevented.
[0047] Moreover, it is equivalent to controlling a refractive index to control the forbidden-band width of face of the 1st guide layer 104 or the 2nd guide layer 106. Therefore, the refractive index of two guide layers 104 and 106 is set as a respectively suitable value, and it becomes possible to adjust a vertical radiation angle.
[0048] Furthermore, the number of the nonluminescent recombination level of the guide layers 104 and 106 can be reduced by setting up smaller than aluminum presentation ratio of the quantum barrier layer 121 aluminum presentation ratio of the guide layers 104 and 106. For this reason, nonluminescent recombination can be controlled to the carrier which began to leak from the quantum well layer 120 to the guide layers 104 and 106. Therefore, a carrier can be used effective in luminescence and reduction of a threshold current is attained.
[0049] In the semiconductor laser component of this operation gestalt 1, when changing aluminum presentation ratio of the 1st guide layer 104 and the 2nd guide layer 106, change of the threshold current at the time of changing forbidden-band width of face was investigated. The relation between the forbidden-band width of face of the guide layers 104 and 106 and a threshold current shows the result to drawing 3 . Here, Eb expresses the forbidden-band width of face by which Elambda is [Eg / width of face / of the 1st guide layer 104 and the 2nd guide layer 106 / forbidden-band] equivalent to the laser oscillation luminous energy of the MQW barrier layer 105 in the forbidden-band width of face of the quantum barrier layer 121, respectively. As for a threshold current, it turns out that a threshold current will decrease from this result if Eg becomes smaller than Eb, and Eg increases conversely rather than the time of Eg=Eb below by Elambda. A threshold current becomes min when Eg fulfills the conditions of following the (2) type especially.
[0050]
Elambda+100 meV<=Eg<=Eb-50meV .... (2)
Thus, a threshold current is greatly dependent on the forbidden-band width of face of the guide layers 104 and 106. That a threshold current will increase here if Eg becomes smaller than Elambda+100meV A carrier begins to leak from the quantum well layer 120 in which the carrier injected into the quantum well layer 120 of the MQW barrier layer 105 adjoins the 1st guide layer 104 and the 2nd guide layer 106 to the 1st guide layer 104 and the 2nd guide layer 106. In order for the carrier in the quantum well layer 120 to shut up and for a rate to fall, it is for a carrier required for an oscillation to increase and for a threshold current to increase.
[0051] Moreover, when Eg is larger than Eb-50meV, since the refractive index of the 1st guide layer 104 and the 2nd guide layer 106 will fall if Eg is larger than Eb-50meV, a threshold current increases, because the light to the MQW barrier layer 105 shuts up, a rate decreases and many currents are needed for an oscillation.
[0052] (Operation gestalt 2) Drawing 4 and drawing 5 show the operation gestalt 2 of the semiconductor laser component of this invention.
[0053] As shown in drawing 4 , this semiconductor laser component On the n-GaAs substrate 201 The n-GaAs buffer layer 202 of 0.5 micrometers of thickness, the 1st cladding layer 203 of n-aluminum0.5Ga0.5As of 1.5 micrometers of thickness, the 1st guide layer 204 of aluminum0.27Ga0.73As of 10nm of thickness, the non dope MQW barrier layer 205, The 2nd guide layer 206 of aluminum0.27Ga0.73As of 10nm of thickness, The 2nd cladding layer 207 of p-aluminum0.5Ga0.5As of 0.2 micrometers of thickness, The p-aluminum0.2Ga0.8As etching block layer 208 of 0.2 micrometers of thickness, the p-GaAs etching stopper layer 209 of 0.003 micrometers of thickness, the 3rd cladding layer 210 of p-aluminum0.5Ga0.5As of 1.2 micrometers of thickness, and the p-GaAs cap layer 211 of 0.8 micrometers of thickness -- MOCVD -- it has the structure which carried out the laminating one by one by law.
[0054] Here, the MQW barrier layer 205 consists of an aluminum0.1Ga0.9As quantum well layer 220 of 10nm of thickness, and an aluminum0.35Ga0.65As quantum barrier layer 221 of 5nm of thickness, as shown in drawing 5 , and it is constituted by the mutual repeat by three layers of this quantum well

layer, and quantum barrier layer two-layer.
[0055] Next, the stripe mask which consists of a photoresist is formed in the front face of the above-mentioned layered product, etching is stopped on p-GaAs etching stopper layer 209 front face by selective etching, and the ridge stripe 212 with a stripe width of face [of a pars basilaris ossis occipitalis] of 2.2 micrometers is formed.
[0056] the both sides of the ridge stripe 212 are embedded -- as -- the 1st current optical confinement layer 213 of n-aluminum0.7Ga0.3As of 0.6 micrometers of thickness, the 2nd current confining layer 214 of n-GaAs of 0.3 micrometers of thickness, and the p-GaAs flattening layer 215 of 0.3 micrometers of thickness -- one by one -- MOCVD -- it is made to grow up by law
[0057] next, the front face of the p-GaAs cap layer 211 and the p-GaAs flattening layer 215 -- a wrap -- like -- the p-GaAs contact layer 216 of 3 micrometers of thickness -- MOCVD -- it is made to grow up by law n mold electrode 217 and p mold electrode 218 are formed in n-GaAs substrate 201 front face and p-GaAs contact layer 216 front face, respectively. Cavity length is adjusted to 375 micrometers by the cleavage method, and 12%, the end-face reflection factor by the side of the optical outgoing radiation of a resonator end face forms 2Oaluminum3 film and Si film in each end face so that the end-face reflection factor on the backside may become 95%.
[0058] In the semiconductor laser component of this operation gestalt 2, when forward voltage was impressed between n mold electrode 217 and p mold electrode 218, slope effectiveness 0.75 W/A of the oscillation wavelength of 0.78 micrometers, the threshold current of 30mA, and a current-optical output property, 70mA of operating currents in 30mW of optical outputs, and operating voltage 1.8V were obtained.
[0059] With the semiconductor laser component of this operation gestalt 2, while making the 1st guide layer 204 and the 2nd guide layer 206 adjoin the quantum well layer 220 as shown in drawing 5 , forbidden-band width of face of the 1st guide layer 204 and the 2nd guide layer 206 is made larger than the forbidden-band width of face of the quantum well layer 220, and forbidden-band width of face of the 1st guide layer 204 and the 2nd guide layer 206 is made smaller than the forbidden-band width of face of the quantum barrier layer 221. Moreover, the p-GaAs etching stopper layer 209 which is by carrying out between the 1st cladding layer 203 and the 3rd cladding layer 210 as for the laser oscillation luminous energy of the MQW barrier layer 205, abbreviation, etc., and has luminescence energy is formed.
[0060] Here, since abbreviation etc. spreads and makes luminescence energy of the p-GaAs etching stopper layer 209 of 0.003 micrometers of thickness which adjoins the p-aluminum0.2Ga0.8As etching block layer 208 of 0.2 micrometers of thickness the laser oscillation luminous energy of the MQW barrier layer 205, this etching stopper layer 209 functions as a saturable absorption layer. According to the saturable absorption effectiveness of this etching stopper layer 209, the self-oscillation which laser oscillation light oscillates in the shape of a pulse happens. In the state of self-oscillation, the longitudinal mode of laser turns into a multimode, and the spectral line width of each longitudinal mode spreads. For this reason, the coherency of laser falls, it is hard coming to win popularity the effect by return light, and a noise can be reduced.
[0061] With this operation gestalt 2, to the set point of 0.78 micrometers of oscillation wavelength, the oscillation wavelength of the produced semiconductor laser component is also set to 0.78 micrometers, and can perform control of oscillation wavelength.
[0062] On the other hand, when forbidden-band width of face of the 1st guide layer 704 of the conventional example and the 2nd guide layer 706 is made equal to the forbidden-band width of face of the quantum barrier layer 711 (conventional gestalt 1), That is, when aluminum presentation ratio of the 1st guide layer 704 and the 2nd guide layer 706 is set to 0.35, to the set point of 0.78 micrometers of oscillation wavelength, a wavelength gap takes place [oscillation wavelength] to 0.77 micrometers, and control of oscillation wavelength becomes difficult.
[0063] With this operation gestalt 2, since this adjoined the p type 2nd cladding layer 207 and has arranged the p-aluminum0.2Ga0.8As etching block layer 208 and the p-GaAs etching stopper layer 209 which become saturable absorption from a low aluminum presentation ratio, diffusion is controlled for

the dopant of the p type 2nd cladding layer 207 in the layer of these low aluminum presentation ratios, and it originates in the diffusion by the side of the MQW barrier layer 205 of an opposite hand having increased conversely.
[0064] On the other hand, conventionally [above-mentioned], with a gestalt 1, since aluminum presentation ratio becomes the same as aluminum presentation ratio of the quantum barrier layer 711 as for the guide layers 704 and 706, it becomes easy to diffuse the dopant of the p type 2nd cladding layer 707 to the quantum well layer 710 of the MQW barrier layer 705, change of aluminum presentation ratio of the quantum well layer 710 will arise by diffusion, and oscillation wavelength will shift to a short wavelength side.
[0065] Thus, this operation gestalt 2 is effective in preventing a wavelength gap. Moreover, change of aluminum presentation ratio of the quantum well layer 220 of the MQW barrier layer 205 by dopant diffusion also affects the thickness of the quantum well layer 220, and the thickness of the quantum barrier layer 221. For this reason, also in electrical characteristics and an optical property, the gap with a design value arises besides a wavelength gap. According to this operation gestalt 2, it also becomes possible to solve such a problem.
[0066] In addition, although the above-mentioned operation gestalt 2 showed the example which adjoins the p-aluminum0.2Ga0.8As etching block layer 208, and forms the p-GaAs etching stopper layer 209 as a saturable absorption layer other than this -- alike -- the inside of p mold cladding layer -- the quantum level of a MQW barrier layer, and abbreviation -- the gestalt which prepares the single quantum well layer of equal quantum level -- the quantum level of a MQW barrier layer, and abbreviation -- the quantum level of the gestalt and MQW barrier layer which prepare the multiplex quantum well layer of equal quantum level, and abbreviation -- it is also possible to consider as the gestalt which prepares a bulk mold semi-conductor layer with equal forbidden-band width of face thicker than 20nm. the above -- the same effectiveness is acquired also in which gestalt.
[0067] Furthermore, although the above-mentioned operation gestalt 2 shows the gestalt which prepares a saturable absorption layer into p mold cladding layer, it is also possible to consider as the gestalt which prepares a saturable absorption layer into n mold cladding layer in addition to it. Namely, what is necessary is just to prepare a saturable absorption layer suitably between p mold cladding layers and n mold cladding layers which sandwich a MQW barrier layer.
[0068] (Operation gestalt 3) Drawing 6 shows the operation gestalt 3 of the semiconductor laser component of this invention.
[0069] As shown in drawing 6 , this semiconductor laser component On the n-GaAs substrate 301 The n-Ga0.5In0.5P buffer layer 302, the n-(aluminum0.7Ga0.3)0.5In0.5p 1st cladding layer 303 of 1.5 micrometers of thickness, the 0.5(aluminum0.4Ga0.6) In0.5P 1st guide layer 304 of 35nm of thickness, the non dope MQW barrier layer 305, The 0.5(aluminum0.4Ga0.6) In0.5P 2nd guide layer 306 of 35nm of thickness, the p-(aluminum0.7Ga0.3)0.5In0.5p 2nd cladding layer 307 and of 1.5 micrometers of thickness, and the p-Ga0.5In0.5p cap layer 308 of 0.3 micrometers of thickness It has the structure which carried out the laminating one by one by molecular beam epitaxy (MBE law).
[0070] Here, the MQW barrier layer 305 consists of a Ga0.5In0.5P quantum well layer of 8nm of thickness, and a 0.5(aluminum0.5Ga0.5) In0.5P quantum barrier layer of 5nm of thickness, and is constituted by the mutual repeat by four layers of this quantum well layer, and three layers of quantum barrier layers.
[0071] Next, selective etching is performed, the stripe mask which consists of a photoresist is formed in the front face of the above-mentioned layered product, etching is stopped so that the remnants thickness of the flat part of the p-(aluminum0.7Ga0.3)0.5In0.5P 2nd cladding layer 307 may be set to 0.3 micrometers, and the ridge stripe 309 with a width of face of 5 micrometers is formed.
[0072] next, the outside of the ridge stripe 309 is embedded -- as -- the n-GaAs current optical confinement layer 310 of 1.2 micrometers of thickness -- MBE -- it is made to grow up by law
[0073] Next, n mold electrode 311 and p mold electrode 312 are formed in n-GaAs substrate 301 front face and p-GaA cap layer 308 front face, respectively. Cavity length is adjusted to 500 micrometers by the cleavage method, and 50%, the reflection factor of the optical outgoing radiation side edge side of a

resonator end face forms 2Oaluminum3 film and Si film in each end face so that the reflection factor on the backside may become 85%.
[0074] With the semiconductor laser component of this operation gestalt 3, when forward voltage was impressed between n mold electrode 311 and p mold electrode 312, slope effectiveness 0.6 W/A of the oscillation wavelength of 0.65 micrometers, the threshold current of 30mA, and a current-optical output property, 35mA of operating currents in 3mW of optical outputs, and operating voltage 2V were obtained. Thus, with this operation gestalt 3, buildup of operating voltage is controlled and a threshold current can be reduced.
[0075] Moreover, with this operation gestalt 3, to the set point of 0.65 micrometers of oscillation wavelength, the oscillation wavelength of the produced semiconductor laser component is also set to 0.65 micrometers, and can perform control of oscillation wavelength.
[0076] On the other hand, when forbidden-band width of face of the 1st guide layer 704 and the 2nd guide layer 706 is made equal to the forbidden-band width of face of the quantum barrier layer 711 (i.e., when aluminum presentation ratio of the 1st guide layer 704 and the 2nd guide layer 706 is set to 0.5) (conventional gestalt 1), to the set point of 0.65 micrometers of oscillation wavelength, a wavelength gap takes place [oscillation wavelength] to 0.64 micrometers, and control of oscillation wavelength becomes difficult. This is for causing a wavelength gap, in order that the dopant of p mold cladding layer 707 may be spread to the MQW barrier layer 705 since it is easy to tend diffuse the dopant of p mold cladding layer 707, and aluminum presentation ratio of the quantum well layer 710 may change.
[0077] Thus, for example, especially by the AlGaInP system cladding layer, it is in the inclination which the dopant of p mold cladding layer tends to diffuse compared with an AlGaAs system cladding layer depending on the class of cladding layer. Therefore, if it is in such a cladding layer, by making forbidden-band width of face of the 2nd guide layer by the side of p mold cladding layer smaller than the forbidden-band width of face of a quantum barrier layer, the diffusion to the barrier layer of a dopant is controlled and a wavelength gap can be prevented much more effectively.
[0078] (Operation gestalt 4) Drawing 7 shows the operation gestalt 4 of the semiconductor laser component of this invention.
[0079] As shown in drawing 7 , this semiconductor laser component On the n-GaAs substrate 401 The n-GaAs buffer layer 402 of 0.5 micrometers of thickness, the 1st cladding layer 403 of n-aluminum0.5Ga0.5As of 1.2 micrometers of thickness, the 2nd cladding layer 404 of n-aluminum0.48Ga0.52As of 0.2 micrometers of thickness, the 1st guide layer 405 of aluminum0.27Ga0.73As of 5nm of thickness, The non dope MQW barrier layer 406, the 2nd guide layer 407 of aluminum0.27Ga0.73As of 5nm of thickness, the 2nd cladding layer 408 of p-aluminum0.5Ga0.5As of 0.15 micrometers of thickness, the p-GaAs etching stopper layer 409 of 0.002 micrometers of thickness, the 3rd cladding layer 410 of p-aluminum0.5Ga0.5As of 1.0 micrometers of thickness, and the p-GaAs cap layer 411 of 0.8 micrometers of thickness -- MOCVD -- it has the structure which carried out the laminating one by one by law.
[0080] Here, the MQW barrier layer 406 consists of an aluminum0.13Ga0.87As quantum well layer of 10nm of thickness, and an aluminum0.35Ga0.65As quantum barrier layer of 5nm of thickness, and is constituted by the mutual repeat by eight layers of this quantum well layer, and seven layers of quantum barrier layers.
[0081] In addition, the n type 2nd cladding layer 404 is not used for control of a vertical radiation angle, and does not affect the effectiveness of this invention.
[0082] Next, the stripe mask which consists of a photoresist is formed in the front face of the above-mentioned layered product, etching is stopped on p-GaAs etching stopper layer 409 front face by selective etching, and the ridge stripe 412 with a stripe width of face [of a pars basilaris ossis occipitalis] of 2.2 micrometers is formed.
[0083] the both sides of the ridge stripe 412 are embedded -- as -- the 1st current optical confinement layer 413 of n-aluminum0.7Ga0.3As of 0.6 micrometers of thickness, the 2nd current confining layer 414 of n-GaAs of 0.3 micrometers of thickness, and the p-GaAs flattening layer 415 of 0.3 micrometers of thickness -- MOCVD -- sequential growth is carried out by law.

[0084] next, the front face of the p-GaAs cap layer 411 and the p-GaAs flattening layer 415 -- a wrap -- like -- the p-GaAs contact layer 416 of 3 micrometers of thickness -- MOCVD -- it is made to grow up by law n mold electrode 417 and p mold electrode 418 are formed in n-GaAs substrate 401 front face and p-GaAs contact layer 416 front face, respectively. Cavity length is adjusted to 200 micrometers by the cleavage method, and 30%, the end-face reflection factor by the side of the optical outgoing radiation of a resonator end face forms 2Oaluminum3 film and Si film in each end face so that the end-face reflection factor on the backside may become 75%.
[0085] In the semiconductor laser component of this operation gestalt 4, when forward voltage was impressed between n mold electrode 417 and p mold electrode 418, oscillation wavelength [of 0.78 micrometers], threshold-current [of 15mA], and current-optical output slope effectiveness 0.75 W/A, 19mA of operating currents of 3mW of optical outputs, and operating voltage 1.8V were obtained.
[0086] With the semiconductor laser component of this operation gestalt 4, the self-oscillation which laser oscillation light oscillates in the shape of a pulse happens using the saturable absorption effectiveness in the MQW barrier layer of the stripe exterior. In the state of self-oscillation, the longitudinal mode of laser turns into a multimode, and the spectral line width of each longitudinal mode spreads. For this reason, the coherency of laser falls, it is hard coming to win popularity the effect by return light, and a noise can be reduced.
[0087] In the semiconductor laser component of this operation gestalt 4, the difference of the minimum spot location of the synchrotron orbital radiation of a horizontal direction and a perpendicular direction, i.e., the astigmatic difference, is set to 5 micrometers at a barrier layer.
[0088] On the other hand, when forbidden-band width of face of the 1st guide layer 704 of the conventional example and the 2nd guide layer 706 is made equal to the forbidden-band width of face of the quantum barrier layer 711 (i.e., when aluminum presentation ratio of the 1st guide layer 704 and the 2nd guide layer 706 is set to 0.35) (conventional gestalt 1), the astigmatic difference of a radiation angle increases to 15 micrometers. If the astigmatic difference increases, when condensing synchrotron orbital radiation with a lens, buildup of a condensing spot size is produced and it becomes difficult to use it by systems, such as an optical disk.
[0089] That is, according to the semiconductor laser component of this operation gestalt 4, the amount of saturable absorption in the stripe exterior of the quantum well layer which adjoins the guide layers 405 and 407 can be increased, and self-oscillation can be caused, confining light in the interior of a stripe. Consequently, it is hard coming to win popularity the effect of the wave front by the saturable absorption effectiveness of the stripe exterior, a gap of the spot location of synchrotron orbital radiation horizontal to a barrier layer becomes small, and the astigmatic difference is improved. Therefore, the astigmatic difference of synchrotron orbital radiation is reduced and it becomes possible to improve an optical property.
[0090] Drawing 8 shows the relation between refractive-index difference deltan of the semiconductor laser component about a gestalt 1, and astigmatic difference deltaZ this operation gestalt 4 and conventionally. Here, refractive-index difference deltan expresses the difference of the rate na of optical refraction confined in the barrier layer inside a stripe, and the rate nb of optical refraction confined in the barrier layer of the stripe exterior. It is admitted that a refractive-index difference is dependent on the astigmatic difference from this result, and, moreover, as for this operation gestalt 4, it turns out that astigmatic difference deltaZ is conventionally stopped low compared with a gestalt 1.
[0091] In order to cause self-oscillation and to make light ooze out to the stripe exterior, it is necessary to make refractive-index difference deltan or less into 7x10 to three. Astigmatic difference deltaZ is in the inclination which increases as refractive-index difference deltan is decreased. With the semiconductor laser component of this operation gestalt 4, for setting astigmatic difference deltaZ to 10 micrometers or less, it is necessary to make refractive-index difference deltan or more into 2x10 to three. So, the low noise semiconductor laser component of the self-oscillation mold which has the good optical property of 10 micrometers or less of astigmatic difference consists of these operation gestalten 4 by setting refractive-index difference deltan as the range which fulfills the conditions of following the (1) type.

[0092]
2x10-3 <=deltan<=7x10-3 .... (1)
On the other hand, with a gestalt 1, astigmatic difference deltaZ becomes larger than 10 micrometers in 7xten to three or less refractive-index difference required to cause self-oscillation conventionally. Therefore, conventionally, with a gestalt 1, the astigmatic difference cannot be reduced and self-oscillation cannot be caused.
[0093] (Operation gestalt 5) Drawing 9 and drawing 10 show the operation gestalt 5 of the semiconductor laser component of this invention.
[0094] As shown in drawing 9 , this semiconductor laser component On the n-GaAs substrate 501 The n-GaAs buffer layer 502 of 0.5 micrometers of thickness, The 1st cladding layer 503 of n-aluminum0.5Ga0.5As of 1.5 micrometers of thickness, the 1st guide layer 504 of aluminum0.3Ga0.7As of 15nm of thickness, the non dope MQW barrier layer 505, the 2nd guide layer 506 of aluminum0.25Ga0.75As of 15nm of thickness, The 2nd cladding layer 507 of p-aluminum0.5Ga0.5As of 0.2 micrometers of thickness, the 1st etching stopper layer 508 of p-GaAs of 0.003 micrometers of thickness, the 2nd etching stopper layer 509 of p-aluminum0.6Ga0.4As of 0.01 micrometers of thickness, the n-aluminum0.5Ga0.5As current optical confinement layer 510 of 1.0 micrometers of thickness, and the n-GaAs cap layer 511 of 0.8 micrometers of thickness -- MOCVD -- it has the structure which carried out the laminating one by one by law.
[0095] Here, the MQW barrier layer 505 consists of an aluminum0.1Ga0.9As quantum well layer 520 of 8nm of thickness, and an aluminum0.35Ga0.65As quantum barrier layer 521 of 5nm of thickness, as shown in drawing 10 , and it is constituted by the mutual repeat by this quantum well layer two-layer and one layer of quantum barrier layers.
[0096] In addition, since the class thickness of the 1st etching stopper layer 508 of p-GaAs and the 2nd etching stopper layer 509 of p-aluminum0.6Ga0.4As is very thin, light shuts up an etching stopper layer and it does not affect an operation or internal optical absorption.
[0097] Next, the stripe aperture which consists of a photoresist is formed in the front face of the above-mentioned layered product, and the stripe slot 512 with a width of face of 2.5 micrometers which arrives at the 1st etching stopper layer front face of p-GaAs by selective etching is formed.
[0098] next, the stripe slot 512 is embedded -- as -- the 3rd cladding layer 513 of p-aluminum0.5Ga0.5As of 1.5 micrometers of thickness, and the p-GaAs contact layer 514 of 2 micrometers of thickness -- MOCVD -- sequential growth is carried out by law.
[0099] n mold electrode 515 and p mold electrode 516 are formed in n-GaAs substrate 501 front face and p-GaAs contact layer 514 front face, respectively. Cavity length is adjusted to 375 micrometers by the cleavage method, and 30%, the end-face reflection factor by the side of the optical outgoing radiation of a resonator end face forms 2Oaluminum3 film in each end face so that the end-face reflection factor on the backside may become 95%.
[0100] In the semiconductor laser component of this operation gestalt 5, when forward voltage was impressed between n mold electrode 515 and p mold electrode 516, slope effectiveness 0.75 W/A of the oscillation wavelength of 0.78 micrometers, the threshold current of 10mA, and a current-optical output property, 14mA of operating currents of 3mW of optical outputs, and operating voltage 1.7V were obtained.
[0101] With the semiconductor laser component of this operation gestalt 5, while making the 1st guide layer 504 and the 2nd guide layer 506 adjoin the quantum well layer 520 as shown in drawing 10 , forbidden-band width of face of the 1st guide layer 504 and the 2nd guide layer 506 is made larger than the forbidden-band width of face of the quantum well layer 520, and forbidden-band width of face of the 1st guide layer 504 and the 2nd guide layer 506 is made smaller than the forbidden-band width of face of the quantum barrier layer 521. Furthermore, the forbidden-band width of face of the 1st guide layer 504 and the 2nd guide layer 506 is changed.
[0102] With this operation gestalt 5, the forbidden-band width of face of the 1st guide layer 504 and the 2nd guide layer 506 differs, namely, aluminum presentation ratios differ. At this time, a vertical radiation include angle is 25 degrees. On the other hand, when forbidden-band width of face of the 1st

guide layer 504 and the 2nd guide layer 506 is made equal (i.e., when both aluminum presentation ratios are set to 0.25), a vertical radiation include angle turns into 30 degrees. Thus, it becomes possible by setting aluminum presentation ratio of both the guides layers 504 and 506 as a suitable value to control the synchrotron orbital radiation property of laser.
[0103] (Operation gestalt 6) Drawing 11 and drawing 12 show the operation gestalt 6 of the semiconductor laser component of this invention.
[0104] As shown in drawing 11 , this semiconductor laser component On silicon on sapphire 601 The GaN buffer layer 602 of 0.05 micrometers of thickness, the 1st cladding layer 603 of n-GaN of 3 micrometers of thickness, the 2nd cladding layer 604 of n-In0.05Ga0.95N of 0.1 micrometers of thickness, the 3rd cladding layer 605 of n-aluminum0.05Ga0.95N of 0.5 micrometers of thickness, The 1st guide layer 606 of non dope In0.1Ga0.9N of 20nm of thickness, the non dope MQW barrier layer 607, the 2nd guide layer 608 of non dope In0.1Ga0.9N of 20nm of thickness, the 4th cladding layer 609 of p-aluminum0.2Ga0.8N of 20nm of thickness, the 5th cladding layer 610 of p-GaN of 0.1 micrometers of thickness, the 6th cladding layer 611 of p-aluminum0.05Ga0.95N of 0.5 micrometers of thickness, and the p-GaN contact layer 612 of 0.2 micrometers of thickness -- MOCVD -- it has the structure which carried out the laminating one by one by law.
[0105] Here, the MQW barrier layer 607 consists of an In0.2Ga0.8N quantum well layer 620 of 4nm of thickness, and an In0.05Ga0.95N quantum obstruction 621 of 8nm of thickness, as shown in drawing 12 , and it is constituted by the mutual repeat by three layers of this quantum well layer, and quantum barrier layer two-layer.
[0106] Next, a stripe-like resist mask is formed in the front face of the above-mentioned layered product, the ridge stripe 630 with a width of face of 2 micrometers is formed by dry etching, and n mold electrode 640 and p mold electrode 641 are formed in the 1st cladding layer 603 of n-GaN, and the p-GaN contact layer 612, respectively. Coating of a dielectric film adjusts so that cavity length may serve as the end-face reflection factor by the side of the optical outgoing radiation of 700 micrometers and a resonator end face, and 30% of end-face reflection factors on the backside by the cleavage method.
[0107] In the semiconductor laser component of this operation gestalt 6, when forward voltage was impressed between n mold electrode 640 and p mold electrode 641, operating voltage 6V at the time of slope effectiveness 0.2 W/A of the oscillation wavelength of 0.41 micrometers, the threshold current of 100mA, and a current-optical output property and a threshold current were obtained. Thus, with this operation gestalt 6, buildup of operating voltage is controlled and a threshold current can be reduced.
[0108] With the semiconductor laser component of this operation gestalt 6, while making the 1st guide layer 606 and the 2nd guide layer 608 adjoin the quantum well layer 620 as shown in drawing 12 , forbidden-band width of face of the 1st guide layer 606 and the 2nd guide layer 608 is made larger than the forbidden-band width of face of the quantum well layer 620, and forbidden-band width of face of the 1st guide layer 606 and the 2nd guide layer 608 is made smaller than the forbidden-band width of face of the quantum barrier layer 621. Furthermore, the forbidden-band width of face of the guide layers 606 and 608 is set up in the medium of the quantum well layer 620 and the quantum barrier layer 621.
[0109] Here, about the relation between the presentation ratio of each semi-conductor layer, and forbidden-band width of face, when In presentation ratio of each semi-conductor layer increases, forbidden-band width of face decreases and a refractive index has the increasing relation. Moreover, when aluminum presentation ratio of each semi-conductor layer increases, forbidden-band width of face increases and a refractive index has the relation which decreases.
[0110] With this operation gestalt 6, since it is controlled by the guide layers 606 and 608 that the dopant from the n-3rd cladding layer 605 and, and the p-4th cladding layer 609 is spread in the MQW barrier layer 607 since the InGaN layer of a non dope is used for the guide layers 606 and 608, it can prevent the oscillation wavelength gap accompanying fluctuation of a presentation ratio.
[0111] Furthermore, since InGaN was applied to the guide layers 606 and 608 and the forbidden-band width of face is set up in the medium of the quantum well layer 620 and the quantum barrier layer 621, the refractive index of the guide layers 606 and 608 can be increased. For this reason, the light to the MQW barrier layer 607 shuts up, a rate is increased, controlling buildup of operating voltage, and it

becomes possible to reduce a threshold current.
[0112] On the other hand, in the conventional example, in order to use the GaN layer of n mold or p mold for the guide layers 704 and 706, the problem that a dopant is spread in the MQW barrier layer 705, and causes an oscillation wavelength gap arises. If the guide layers 704 and 706 are made a non dope in order to prevent it, another problem that operating voltage increases will arise.
[0113] In addition, although each above-mentioned operation gestalt described the case where forbidden-band width of face of the 1st guide layer and the 2nd guide layer was made smaller than the forbidden-band width of face of a quantum barrier layer, it is also possible to make forbidden-band width of face of either the 1st guide layer or the 2nd guide layer smaller than the forbidden-band width of face of a quantum barrier layer.
[0114] Moreover, it is not limited to presentation ratios, such as thickness shown with each above-mentioned operation gestalt, and aluminum, In, and carrier concentration, and this invention can also be considered as the other conditions.
[0115] moreover -- a grown method -- MOCVD -- law and MBE -- law -- except -- LPE -- law and the gas source MBE -- law and ALE (atomic-line epitaxy) -- it is also possible to apply law.
[0116]
[Effect of the Invention] Since according to the semiconductor laser component of above-mentioned this invention forbidden-band width of face of a guide layer was made smaller than the forbidden-band width of face of a quantum barrier layer, namely, the refractive index of a guide layer is set up more greatly than the refractive index of a quantum barrier layer, the light to the quantum well layer of a MQW barrier layer can shut up, a rate can be increased, and a threshold current can be reduced. In addition, since it is not necessary to thicken thickness of a guide layer like the conventional example, buildup of the operating voltage accompanying buildup of component resistance can also be controlled, and a threshold current can be reduced.
[0117] Moreover, since forbidden-band width of face of a guide layer was made smaller than the forbidden-band width of face of a quantum barrier layer, for example, aluminum presentation ratio of a guide layer is set up smaller than aluminum presentation ratio of a quantum barrier layer in the case of aluminum system semi-conductor layer, the dopant diffusion to a guide layer from a cladding layer can be controlled. Consequently, since the dopant diffusion to a MQW barrier layer can be controlled, change of aluminum presentation ratio of the quantum well layer of a MQW barrier layer can be controlled, and an oscillation wavelength gap can be prevented.
[0118] Moreover, it can be equivalent to controlling a refractive index to control the forbidden-band width of face of a guide layer, it can set the refractive index of two guide layers as a respectively suitable value, and can adjust a vertical radiation angle.
[0119] Furthermore, since the number of the nonluminescent recombination level of a guide layer can be reduced by setting up aluminum presentation ratio of a guide layer smaller than aluminum presentation ratio of a quantum barrier layer, nonluminescent recombination can be controlled to the carrier which began to leak from a quantum well layer to the guide layer. Consequently, a carrier can be used effective in luminescence and a threshold current can be reduced.
[0120] Moreover, since the configuration which prepares the saturable absorption layer which is in the forbidden-band width of face of the laser oscillation light of a MQW barrier layer, abbreviation, etc. by carrying out, and has the forbidden-band width of face of luminescence energy between two cladding layers is taken especially according to claim 2 and a semiconductor laser component according to claim 3, the self-oscillation which laser oscillation light oscillates in the shape of a pulse according to the saturable absorption effectiveness happens. In the state of self-oscillation, the longitudinal mode of laser turns into a multimode, and the spectral line width of each longitudinal mode spreads. For this reason, the coherency of laser falls, it is hard coming to win popularity the effect by return light, and a noise can be reduced.
[0121] In addition, when based on the configuration which prepares this saturable absorption layer, it is possible that diffusion is controlled for the dopant of the cladding layer between a MQW barrier layer and a saturable absorption layer in a saturable absorption layer, and the diffusion by the side of a MQW

barrier layer increases, but since aluminum presentation ratio of a guide layer is set up smaller than aluminum presentation ratio of a quantum barrier layer, the dopant diffusion to a guide layer from a cladding layer can be controlled. Therefore, since the dopant diffusion to a MQW barrier layer can be controlled, change of aluminum presentation ratio of the quantum well layer of a MQW barrier layer can be controlled, and an oscillation wavelength gap can be prevented.

[0122] Moreover, since especially according to the semiconductor laser component according to claim 4 the stripe-like 3rd cladding layer is prepared and the above-mentioned refractive-index difference deltan is set up within the limits of the above-mentioned (1) formula, the amount of saturable absorption in the barrier layer of the stripe exterior is increased, and self-oscillation can be caused, confining light in the interior of a stripe. Consequently, it is hard coming to win popularity the effect of the wave front by the saturable absorption effectiveness of the stripe exterior, and a gap of the spot location of synchrotron orbital radiation horizontal to a barrier layer can be made small, namely, the astigmatic difference is reduced, and an optical property can be improved.

[0123] Moreover, especially according to the semiconductor laser component according to claim 5, since forbidden-band width of face of the 2nd guide layer by the side of p mold cladding layer is made smaller than the forbidden-band width of face of a quantum barrier layer, to the cladding layer in the inclination which the dopant of p mold cladding layer tends to diffuse like an AlGaInP system cladding layer, for example, the diffusion to the barrier layer of a dopant is controlled and a wavelength gap can be prevented much more effectively.

[0124] Moreover, especially according to the semiconductor laser component according to claim 6, since the forbidden-band width of face of the guide layer of the smaller one is set up more greatly than the forbidden-band width of face equivalent to the laser oscillation luminous energy of a barrier layer, as it is shown in drawing 3 among the forbidden-band width of face of two guide layers, a threshold current can be reduced much more effectively.

[0125] Moreover, especially according to the semiconductor laser component according to claim 7, among the forbidden-band width of face of two guide layers, since the forbidden-band width of face Eg of the guide layer of the smaller one is set up so that the relation of the above-mentioned (2) formula may be filled, as shown in drawing 3 , a threshold current can be reduced much more effectively.

[Translation done.]